

CLAIMS

1. An apparatus for inspection of at least one security article incorporating a diffractive optical projection element as a security device, wherein the apparatus comprises:
  - 5 a light source for directing a beam of light onto said diffractive optical projection element which transforms the beam into a patterned beam of light that is reconstructed at a particular position in space to form a projected image; and  
at least one optical detection device located at the position at which the patterned beam of light is reconstructed to form the projected image.
- 10 2. An apparatus according to claim 1 wherein the light source is arranged to direct a substantially collimated beam of light onto the diffractive optical projection element.
3. An apparatus according to either claim 1 or claim 2 wherein the light source is a point light source.
- 15 4. An apparatus according to claim 3 wherein the light source is any one of:  
a light emitting diode (LED); or  
a halogen light source; or  
a laser.
- 20 5. An apparatus according to any one of claims 1 to 4 wherein the optical detection device is arranged to detect the amplitude of different parts of the patterned light beam forming the projected image.
6. An apparatus according to claim 5 wherein the optical detection device comprises one or more photodiodes.
- 25 7. An apparatus according to claim 5 wherein the optical detection device comprises a charge coupled device (CCD).

8. An apparatus according to any one of claims 1 to 7 wherein the diffractive optical projection element is provided in a substantially transparent or translucent portion or window in the security article, the light source is positioned on one side of a security article and the detection means is positioned on the opposite side of the security article such that the light passes through the diffractive optical projection element so that the incident beam is transformed into the patterned beam on the opposite side of the document and projected onto the optical detection device.
9. An apparatus according to any one of claims 1 to 7 wherein the diffractive optical projection element is provided on an underlying reflective surface, and the light source and optical detection device are positioned on the same side of the security article such that the optical detection device detects a reflected beam transformed by the diffractive optical projection element into the patterned beam and projected onto the optical detection device.
10. An apparatus according to any one of claims 1 to 9, wherein the apparatus is incorporated into at least one of:  
printing equipment; or  
counting equipment; or  
handling equipment.
11. An apparatus according to any one of claims 1 to 10 wherein the apparatus includes a plurality of optical detection devices.
12. An apparatus according to any one of claims 1 to 11 wherein the apparatus includes a plurality of light sources for illuminating at least one diffractive optical projection element.
13. An apparatus according to claim 12 wherein each of the light sources causes a patterned beam to be diffracted at a slightly different point on the optical detection device, creating multiple signals at the optical detection device.

14. An apparatus according to any one of claims 1 to 11 wherein the light source is a moving light source which produces an incident light beam that scans across the diffractive optical projection element to create multiple signals at the optical detector.
- 5 15. An apparatus according to any one of the preceding claims, further including a processor for processing signals from the optical detection device.
16. An apparatus according to claim 15 wherein the processor analyses multiple signals to differentiate constructive diffraction produced by the diffractive optical element from a random or diffuse scattering of light.
- 10 17. A method for inspection of at least one security article, wherein the security article incorporates a diffractive optical projection element as a security device, and wherein the method comprises the steps of:
- directing a beam of light from a light source onto said diffractive optical projection element which transforms the beam into a patterned beam of light that
- 15 is reconstructed at a particular position in space to form a projected image; and
- detecting the projected image with an optical detection device located at the position at which the patterned beam of light is reconstructed to form the projected image.
- 20 18. A method according to claim 17 wherein the step of directing a beam of light includes directing a substantially collimated beam of light onto the diffractive optical projection element.
19. A method according to claim 17 or claim 18 wherein the step of detecting the projected image includes detecting the amplitude of different parts of the patterned beam of light forming the projected image.
- 25 20. A method according to any one of claims 17 to 19 wherein the diffractive optical projection element is provided in a substantially transparent or translucent portion or window in the security document, the beam of light is directed from the light source onto the diffractive optical projection element from one side of a

security document and through the diffractive optical projection element and detecting the projected image on the opposite side of the security document.

21. A method according to any one of claims 17 to 19 wherein the diffractive optical projection element is provided on an underlying reflective surface, and the  
5 beam of light is directed and the projected image is detected from the same side of a security document.

22. A method according to claim 21 wherein the diffractive optical projection element is provided in a transparent window which has a reflective layer within the window, and the beam of light is directed at an acute angle to the surface of  
10 the window outside the diffractive optical projection element so that the beam of light reflected from the reflective layer passes through the diffractive optical projection element to the optical detection device.

23. A method according to any one of claims 17 to 21 wherein a plurality of beams of light are directed from a plurality of beams of light are directed from a  
15 plurality of light sources onto the diffractive optical projection element so that a plurality of patterned beams of light are produced and form multiple signals.

24. A method according to any one of claims 17 to 22 further including directing a beam of light from a moving light source such that the directed light beam scans across the diffractive optical projection element to create multiple  
20 signals at the optical detection device.

25. A method according to any of claims 17 to 24 further including the step of processing signals from the optical detection device.

26. A method according to claim 25 wherein the step of processing signals includes integrating and sampling multiple signals over a period of time to  
25 differentiate constructive diffraction produced by the diffractive optical elements from a random or diffuse scattering of light,

27. A method of processing or handling security articles comprising a method for inspection in accordance with any one of claims 17 to 26, wherein a signal is generated when the absence or poor quality of a diffractive optical projection element is detected in a security article.

- 5 28. A method of processing or handling security articles as claimed in claim 27 wherein the security article is isolated or marked when the signal is generated by the optical device.

29. Equipment for sorting, handling, counting or otherwise processing security documents, the equipment including:

- 10 a detector for detecting the presence of a security document;  
a window locator for locating a window in the security document incorporating a diffractive optical element;  
a light source for directing a beam of light through said diffractive optical projection element in said window whereby the diffractive optical projection  
15 element produces a patterned beam of light which forms a projected image;  
an optical detection device located at a position at which the patterned beam of light is reconstructed to form the projected image;  
a processor for processing and analysing signals from the optical detection device; and  
20 a document processing means for processing the security documents according to the signals from the optical detection device.

30. Equipment according to claim 29 wherein the processor generates a rejection signal when the absence or poor quality of a diffractive optical projection element is detected by the optical detection device.

- 25 31. Equipment according to claim 29 or claim 30 wherein the processor comprises a process logic controller (PLC) or a microprocessor to determine the presence of a diffractive optical projection element in the window.

32. Equipment according to claim 31 wherein the PLC or the microprocessor determines the quality of the diffractive optical projection element by inspection of the projected image formed by the patterned beam.

5 33. Equipment according to claim 32 wherein the PLC or the microprocessor outputs an accept or reject signal based on the quality of the diffractive optical projection element.

34. Equipment according to any one of claims 29 to 33 further including a barcode printer.

10 35. Equipment according to claim 34 wherein the barcode printer prints either an accept or reject code on the security document in accordance with the output of the processor.

36. Equipment according to claim 34 wherein the document processing means processes the security documents in accordance with the code printed by the barcode printer.

15 37. Equipment according to any one of claims 29 to 36 wherein the detector for detecting the presence of a security document is an edge detector which detects the edge of a security document.

38. Equipment according to any one of claims 29 to 37 wherein the document processing means includes a document sorter.

20 39. Equipment according to any one of claims 29 to 37 wherein the document processing means includes a counter for counting security documents.

40. Equipment according to any one of claims 28 to 36 wherein the document processing means includes a document printer.

25 41. Equipment for sorting, handling or otherwise processing security articles, the equipment comprising:

inspection apparatus in accordance with any one of claims 1 to 15; and  
article processing means for subsequently processing the security articles  
according to signals from the detection means.